Burma	1
„ and Cochin-China	1
Assam	8
Orissa	1
Madras, Assam, and Burma	1
Base of Neilgherry hills in Madras	2
South India and Malabar	1
„ „ Ceylon	1
Ceylon	1
„ and Java	1
West coast of India and Malay archipelago	1
„ „	6
„ „ and Coimbatore	1

The foregoing shows that the 78 species are restricted to the Indian region (including Burma and Ceylon); 6 are distributed from the Indian region (excluding Ceylon) to the Malay archipelago, and 1 extends from Ceylon to the Malay archipelago. Consequently we find no species of Indian freshwater Siluroid extending its range to Africa, whereas 6 do to the Malay archipelago.

Of the genera, as I have already remarked, only 1 is common to India and Africa, whilst that is also found in the Malay archipelago, which possesses 10 more Indian genera.

So far, results would appear to show us that the present race of freshwater fishes of India is much more closely related to a Malayan than it is to an African fish-fauna.

Notes on the Genus *Alveolites*, Lamarck, and on some allied Forms of Palæozoic Corals. By Prof. H. Alleyne Nicholson, M.D., D.Sc., F.R.S.E., F.L.S., and Robert Etheridge, Jun., F.G.S.

[Read May 3, 1877.]

(Plates XIX. & XX.)

We have recently had occasion to examine a large series of specimens of that group of corals to which the name of "*Alveolites*" is generally given, as well as of various allied forms, from the Carboniferous rocks of the north of England and south of Scotland, the Devonian rocks of Devonshire and North America, and the Upper Silurian rocks of England, Sweden, and the United States; and we have found our progress greatly impeded by the very unsatisfactory condition in which *Alveolites* stands at present. Not only does it appear to be evident that the name *Alveolites* covers a number of forms which are not always united by relations of genuine affinity, but even those forms which may be regarded as the *types* of *Alveolites* are only separable from certain allied groups by characters difficult to define or discover, and sometimes of dubious value and uncertain interpretation. Under these circumstances, it may not be useless that we should lay before our fellow workers the results of our researches so far as they have gone at present, more by way of discussion and suggestion than of dogmatizing or of laying down positive conclusions or formulating final definitions.

The genus *Alveolites* was originally founded by Lamarck in the first edition of the 'Système des Animaux sans Vertèbres' (published in 1801), p. 375, for the reception of a single Devonian species which he described under the names of *A. suborbicularis* and *A. escharoides*, and for which the former title has been subsequently retained. The original definition is, "Polypary stony, thick, globular or hemispherical, formed of numerous concentric layers, which are superimposed one upon the other, each layer formed by the union of alveolar, subtubular, prismatic, contiguous cellules [or tubes], forming a network on the surface." In the 'Hist. Nat. des Anim. sans Vertèb.' (published in 1816), vol. ii. p. 184, the same definition is given with very slight alterations, the principal change being that the genus is now made to include incrusting forms. In the second edition of Lamarck's 'Hist. Nat. des Anim. sans Vertèbr.' (published in 1836), the portion relating to the corals was revised by Milne-Edwards, and the genus *Alveolites* is defined as follows (vol. ii. p. 285):—

"Corallum stony, sometimes incrusting, sometimes free and massive, formed of numerous layers which are concentrically superimposed upon one another, each layer composed of tubular, alveolar, prismatic cellules, which are somewhat short, and form a network on the surface." Four species of the genus were recognized by Lamarck, of which *A. suborbicularis* and *A escharoides* have been subsequently united with one another. *A. madreporacea* is stated by Milne-Edwards to be a *Pocillopora*; and *A. incrustans* appears to be a Polyzoön. To the above four species Milne-Edwards added, in the work just quoted, four others, of which

A. tubiporacea and *A. milleporacea* appear to be referable to *Favosites*; *A. clavata* may perhaps be a *Chætetes*; and *A. infundibuliformis* was afterwards placed by Edwards and Haime in a new genus under the name of *Rœmeria.*

Without taking up time by discussing the views entertained as to the characters of the genus *Alveolites* and the different forms referable to it by Goldfuss, De Blainville, Michelin, Steininger, D'Orbigny, and other well-known palæontologists, we may pass on to consider those expressed by Milne-Edwards and Jules Haime in their great works on the fossil corals. In the Introduction to the 'Monograph of the British Fossil Corals' (Palæontographical Society, 1850, p. lx), these distinguished authorities place the genus *Alveolites* in the group of the Favositidæ proper, characterized by the presence of well-developed tabulæ, the existence of mural pores, and the rudimentary condition of the septa. They define the genus as possessing a "corallum composed of superposed strata of corallites very similar to those of *Favosites*, but much shorter, and terminated by an oblique semicircular or subtriangular calice, the edge of which projects on one side." The type species of the genus is *A. spongites*, Steininger (=*A. suborbicularis*, Lamarck). In their 'Polypiers Fossiles des Terrains Paléozoiques' (p. 254), the same authors in the succeeding year redefine *Alveolites* as follows:—"Corallum forming a convex or dendroid mass. Calices oblique, subtriangular or semicircular, presenting interiorly a longitudinal protuberance which is opposed to two other smaller protuberances. These eminences appear to represent the primary septa; and no other traces of the septal apparatus can be detected. The walls are simple, well developed, pierced with a small number of mural pores. The tabulæ are complete and horizontal." After giving a history of the genus, the authors just quoted remark that the elongated teeth or eminences above alluded to constitute the most remarkable feature of the genus *Alveolites*, and that they are to be regarded as so many primary septa, the other three which form the normal cycle of six being aborted. They further add that one of these three septal teeth is always more pronounced than the other two, and that these latter may be wholly wanting.

In the 'Histoire Naturelle des Coralliaires' (vol. iii. p. 263, 1860), Milne-Edwards makes the following remarks as to *Alveolites*:—"The most striking character of *Alveolites* is furnished by the *septal system*, which is represented by three teeth or vertical projections—one situated on the inside face of the outer lip of the calice, the others opposite the preceding, upon the inner lip of the corallite, and sometimes rudimentary. The calices are *oblique*, subtriangular or subhemispherical. Walls simple, well developed, and pierced by a small number of pores. Tabulæ complete and horizontal.". . . . "The elongated teeth or vertical projections which we see in the interior of the visceral chambers of the corallites *form the most peculiar character of Alveolites*, and recall the three principal septa which characterize the genus *Heterocœnia* amongst the Astræidæ. . . . It is also worthy of note that one of the septal projections is more developed than the other two, and often it alone may exist.

In briefly analyzing the above, it will be obvious, in the first place, that Lamarck's definition of the genus *Alveolites* does not contain a single character which would at the present day be regarded as of generic importance at all; so that the ultimate existence of the genus will depend upon whether the type species, *A. suborbicularis*, Lam., can be shown to possess characters which separate it generically from allied forms. In the second place, the various definitions given by Milne-Edwards and Haime yield, upon collation, the following characters as essentially distinctive of the genus *Alveolites* as understood by them:—(1) The corallites are furnished with lamellar walls, and are not united by any cœnenchyma. (2) The visceral chamber is traversed by well-developed horizontal tabulæ. (3) Mural pores, comparatively large and few in number, are present. (4) The corallites are oblique, shorter than in *Favosites*, and terminated by *oblique semilunar* or *subtriangular calices*. (5) There exist in the interior of each corallite three elongated teeth, which represent the primary septa, and of which one is always larger than the others, and may be the only one present. (6) The corallites are arranged in the massive and incrusting forms in superimposed layers.

Alveolites suborbicularis, Lam., the type species, possesses all the above-mentioned characters, and is therefore, to begin with, clearly a member of the Favositidæ proper. In order, however, to establish the validity of the genus *Alveolites*, it is further necessary to prove that *A. suborbicularis* is generically separable from *Favosites*; and there are only two of the above-mentioned characters, namely the obliquity of the calices and the presence of septal teeth, which require special consideration in this connexion. Moreover, even if the generic distinctness of *A. suborbi-*

cularis and its immediate allies be satisfactorily established, there still remain various forms more or less resembling *A. suborbicularis*, which differ considerably from it in minute structure, and which must therefore be referred to different groups. In what follows we shall briefly state the results of our examination of a large number of such forms, which we may provisionally arrange in groups according to their affinities. We need only add that our observations, when practicable, have been conducted by means of transparent microscopic sections, as well as by the examination of the actual specimens themselves.

Group A. ALVEOLITES SUBORBICULARIS, *Lamarck.*

The characteristic Devonian coral known under the above name is thus described by Milne-Edwards and Haime ('Brit. Foss. Cor.' p. 219).

"*Corallum* composite, forming irregular incrustated masses which are in general fixed on ramose *Favosites* or on a *Cyathophyllum*, and are composed of superposed layers terminated by an irregular or subgibbose surface. *Calices* very oblique, closely set (but unequally so), elongated transversely, subtriangular, and turned towards the edge of the corallum. The outer or under side of these calices bears interiorly a small elongated ridge which appears to represent a septum, and is placed opposite to a small notch. Transverse diameter of the calices about $\frac{2}{5}$ of a line; small diameter about half that length."

As this is the type species of the genus, it will be advisable to somewhat minutely examine its characters as set forth in the above description, together with some others not mentioned therein, with the view of determining, if possible, which of them possess a more than merely specific value.

In the first place, one of the most conspicuous *external* characters of *Alveolites suborbicularis* is that the corallites are oblique, with the result that the calices are correspondingly oblique, one lip being shorter than the other, and the aperture being more or less elongated transversely, and subtriangular or semilunar in shape. Though this presents a superficially conspicuous feature whereby to separate *Alveolites* from *Favosites*, it is quite evident that this character is by no means one of generic value. Not only is it possessed by forms otherwise different, but it is absent in some corals which are usually placed in *Alveolites* (*e. g.* in *A. septosa*, Flem.). It has, moreover, been pointed out by Dr. Lindström ('Ann. Nat. Hist.' ser. 4, vol. xviii. p. 12) that the well-known coral described by Milne-Edwards and Haime under the name of *A. Fougtii* is in reality only provided with oblique corallites when young, and that in its adult state the tubes lose much of their previous inclination, and the calices become simply irregular in form. As *A. Fougtii* shows, in addition, the numerous regularly arranged mural pores and the obscure septal striæ of *Favosites*, Lindström has removed it from *Alveolites* to the latter genus; and the specimens which the Swedish palæontologist has kindly supplied to us would appear to fully warrant this step.

In the second place, *A. suborbicularis* has the walls of the corallites perforated by mural pores, which are admirably displayed in polished sections. The pores are of large size, placed at irregular but moderate intervals (from $\frac{1}{3}$ to $\frac{1}{2}$ a line or more) apart, and arranged in *single* rows on the sides of the tubes. Though the mural pores are few, irregular, and comparatively of large size, and thus differ from the numerous, regularly placed pores of *Favosites*, it is quite clear that this feature cannot possibly be made one of generic value. Indeed, though excellently seen in the present species, many of the forms with small tubes can hardly be proved to possess these openings at all, save by some chance specimen in some special state of preservation. The presence or absence of mural pores is thus a feature upon which great classificatory value cannot be set in practice, though theoretically the point is one of high value and deserving of all attention. In many instances, however, even where the specimens are excellently preserved, it is impossible to determine whether mural pores exist or not; and this is particularly the case in *Alveolites*, where the tubes are comparatively minute and the mural pores few and scattered. In these cases one has hardly any thing to rely upon except the *chance* that a transparent longitudinal section may lay bare the wall of one of the tubes, and may thus bring to light the mural pores. Very often, however, longitudinal slices fail to reveal any pores, even in forms which are with certainty known to possess them; so that the mere fact of their apparent absence can only be allowed to count for very little. Moreover we have found that numerous specimens of *Favosites*, in all other respects in a state of the most admirable preservation, fail to exhibit the smallest traces of mural pores, though these openings are both numerous and close-set in this genus. It is therefore clear that the visibility of the mural pores depends greatly upon the condition of fossilization, though it is very difficult to say why some specimens should show them conspicuously whilst others, apparently in an absolutely identical state of preservation and taken from the same bed, show no traces of them.

In the third place *A. suborbicularis* possesses numerous complete tabulæ; but these structures present nothing to distinguish them from the tabulæ of *Favosites*.

Fourthly, the corallites of *A. suborbicularis* are short, and are superimposed on one another in successive concentric layers. These characters, though sufficient to superficially distinguish specimens from examples of the more typical forms of *Favosites*, are obviously of nothing more than specific value. Similar features are found in some species of *Favosites*, while such forms of *Alveolites* as *A. septosa*, Flem., have comparatively long corallites.

Lastly, *A. suborbicularis* exhibits the curious feature that there occurs on the outer lip of the calices a single elongated ridge, which is believed to represent a single primary septum. Our specimens of this species, being wholly polished slices from the Devonian of Devonshire, fail to show this character; but it has been fully described by Milne-Edwards and Haime, and it is excellently figured by Goldfuss (Petref. Germ. Taf. xxviii. fig. 1, *h*). That this tooth-like ridge is, in the case of *this* species, truly a rudimentary septum seems highly probable. It is apparently constant in position, and in its development, and it appears to be present in all the calices in well-preserved specimens. What may be its classificatory value we shall discuss immediately, merely stating now that it is evidently quite different in its nature from the so-called "septal teeth" of such corals as *A. septosa*, Flem., and *A. depressa*, Flem.

A. Labechei, Edw. & H., is in many respects closely allied to *A. suborbicularis*, Lam.; but Milne-Edwards and Haime state that it has a septal ridge resembling that of the latter species, but only "slightly developed," or "very indistinct." *A. Grayi*, Edw. & H., is also closely related to the preceding, the septal ridge in the interior of each corallite being "in general distinct, but not very prominent." We have not been able to examine this last-named species fully; but we have not succeeded in detecting the septal ridge in such examples of *A. Labechei* as have come under our notice (from the Upper Silurian of Dudley and of Sweden).

A. compressa, E. & H., is another massive form allied to *A. suborbicularis*. It is stated by Milne-Edwards and Haime to possess three septal teeth, which do not differ in size. So far as our observations go, the calices certainly do exhibit tooth-like processes extending into the interior of the visceral chamber; but we have not been able to make out that the number of these is constant, nor are we satisfied that they are identical in their nature with the septal ridge of *A. suborbicularis.*

A. Battersbyi, Edw. & H., unquestionably possesses spiniform septa, several of these being placed in general round the circumference of a single calice. Not only are these septal spines more numerous than the ridges or teeth of *A. suborbicularis* or *A. compressa*, but *A. Battersbyi* seems in all essential respects to be a genuine *Favosites*, various species of the latter genus having distinct though rudimentary septa.

Various other forms of *Alveolites* have been stated to possess from one to three septal teeth (such as *A. denticulata*, Edw. & H., *A. repens*, Fougt, and *A. cryptodens*, Billings); but we are not sufficiently acquainted with these to pronounce any opinion as to their structure. *A. septosa*, Flem., and *A. depressa*, Flem., are also provided with structures which have been generally regarded as septal teeth; but we shall discuss the nature of these subsequently.

In the meanwhile it is evident that the question as to the validity of the genus *Alveolites* will turn wholly upon the view which may be taken as to the structure of *A. suborbicularis*, Lam., the original type of the genus; and it seems tolerably certain that with this we may place *A. compressa*, E. & H., *A. Labechei*, E. & H., and *A. Grayi*, E. & H., at any rate provisionally. We have seen that the genus *Alveolites*, as thus typified, agrees with *Favosites* in the possession of corallites with lamellar walls not united by a cœnenchyma, in the existence of mural pores, and in the possession of complete and well-developed tabulæ. We have further seen that the obliquity of the calices, the shortness of the corallites, the size and number of the mural pores, and the fact that the corallum is composed of superimposed layers cannot be regarded as points of more than specific value. There remains, then, only to consider whether the presence of from one to three septal ridges (accepting this interpretation of their nature) in the forms just mentioned can be regarded as sufficient to separate them generically from *Favosites*. We have satisfied ourselves that no other character can be brought forward which is sufficiently important to elevate *Alveolites* to the rank of a genus distinct from *Favosites*; and this view seems in the main to be precisely that held by Milne-Edwards and Haime. With our present knowledge it seems unwise to abandon the genus *Alveolites* altogether; but it is at the same time perhaps improbable that future investigations will justify its permanent retention. Rudimentary septa are by no means unknown in *Favosites*, though not so regularly disposed or so striking by their isolation as in *A. suborbicularis*; and genera founded upon *single* characters may be at any moment overthrown by the discovery of intermediate forms.

Group B. Cœnites, Eichwald.

With regard to the genus *Cœnites*, Eichw., we wish merely to suggest the possibility that it may ultimately have to be suppressed if the genus *Alveolites* be retained for *A. suborbicularis* and its immediate allies. The genus was originally founded by Eichwald in 1829 (Zool. Spec. i. p. 197), and was defined by him in the 'Lethæa Rossica' (vol. i. p. 457) as comprising dendroid or lamellar and incrusting corals, with semicircular or triangular calices, provided with a single rudimentary septal ridge on their lower lips, the corallites being united by an abundant cœnenchyma. In all the above-mentioned characters, except the alleged presence of a cœnenchyma, the genus cannot be separated from *Alveolites* as represented by *A. suborbicularis*. The presence of a cœnenchyma would doubtless be sufficient ground for generic distinction; but the few observations we have been able to make on this point lead us to doubt if a true cœnenchyma exists at all in *Cœnites*. More especially, we have examined specimens of *C. orientalis*, Eichwald (supplied to us from the Upper Silurian of Gotland through the kindness of Dr. Lindström), by means of thin sections prepared for the microscope; and in this form we find the apparent cœnenchyma to be due to a secondary thickening of the walls of the corallites, more particularly in the neighbourhood of their mouths, the external boundaries of the tubes remaining quite distinct.

Group C. Pachypora, *Lindström.*

In 1873 Lindström ("Några Anteckningar om *Anthozoa Tabulata*," Öfversigt af. K. Vetensk.-Akad. Förhandl.) gave the name of *Pachypora* to a new genus of corals, to which he assigned the following characters:—"Calices annular, at the extremities of the branches obliquely semilunar, with sparse spiniform septa. The calices surrounded by dense, delicate, concentric laminæ, so as to be superficially remote. Walls perforated with canals." The only species described is *P. lamellicornis*, which is stated to possess flattened branches, often coalescent and forming broad laminæ, the tabulæ being extremely few or inconspicuous.

Dr. Lindström has kindly furnished us with specimens of *P.*

lamellicornis from the Upper Silurian of Wisby; and after a careful microscopic examination of its characters, we are enabled to entirely confirm his description. We have also fully examined two corals from the Devonian of North America, which were originally referred to *Alveolites*, but which we find to be essentially identical with *Pachypora*, and therefore to be properly referable to this genus. The corals in question are *Alveolites Fischeri*, Billings, and *A. frondosa*, Nich.

A. Fischeri, Bill., agrees in all important points with *Pachypora lamellicornis*, Lindström, though specifically distinct. It forms flattened expansions or fronds, rarely incrusting foreign bodies, from one to four lines in thickness, and often of considerable size. The corallites are disposed obliquely to the surfaces, diverging in opposite directions from a central plane, and opening by distinct calices on both aspects of the frond. The walls of the corallites are thickened as they approach the surface, and are formed of numerous delicate concentric laminæ where they surround the calices. The calices are oval or rounded, often semilunar, remote, and neither exhibiting a single septal tooth nor rudimentary spiniform septa. The walls of the corallites are perforated with a few remote mural pores of large size; and the tabulæ are either absent or are few and remote.

In all the above characters *A. Fischeri* agrees with *Pachypora lamellicornis*, save in wanting the comparatively numerous rudimentary septa which can be observed in well-preserved examples of the latter. We have no hesitation, therefore in referring the two to the same generic group; and *A. Fischeri* must in future stand as *Pachypora Fischeri*.

Alveolites frondosa, Nich., also from the Devonian of North America, agrees in all the essential features of its organization with the preceding, and must therefore be removed to the genus *Pachypora*. It differs from *P. Fischeri*, however, in the comparatively small size of the corallites, and the fact that the calices are distinctly semilunar or subtriangular, often curved and fissure-like. In well-preserved examples also there are indications of the existence of two small tooth-like inward projections of the lower lip of the calice, thus establishing a passage between *Pachypora* and the forms generally referred to *Cœnites*, Eichw. The mural pores appear to be few and remote; and we have been unable to detect tabulæ in longitudinal sections of this species.

Group D. ALVEOLITES SEPTOSA, *Fleming*.

Our specimens of this species form hemispherical or pyriform masses, sometimes of great size (reaching occasionally a foot and a half in diameter and five or six inches in height), and have been derived from the Carboniferous Limestone series of Scotland. The composition of these masses varies in different cases. In some examples from Ecclefechan the corallum is composed of numerous concentric layers, each layer being of comparatively small thickness. In other examples, as in some huge masses from the Carboniferous Limestone series of Dunbar, the corallites are long and basaltiform, extending the whole height of the corallum. In both cases the corallites may fairly be said to be *erect*, in the same sense that this term is applied to the position of the corallites in a similarly shaped mass of *Favosites* or *Chætetes*; that is to say, the corallites in a hemispherical corallum are vertical in the centre of the mass, and curve gently outwards as the margins are approached, thus having their terminal portions always directed at right angles to the surface upon which they open. Hence the *calices* entirely want the obliquity which is so characteristic of *Alveolites suborbicularis* and its allies. A reference to the figures of *A. septosa* given by Milne-Edwards and Haime in the Monograph of the British Corals (pl. xlv. fig. 5 *b*) will at once show that the calices of this species, instead of being like those of *Alveolites suborbicularis*, entirely resemble in this respect the calices of any massive *Favosites* or *Chætetes*.

The calices in our specimens of *A. septosa* are from three to four in a line, generally the former, their shape being somewhat irregular, but on the whole five- or six-sided, or at any rate more or less prismatic. In places the calices become transversely elongated; but they never assume the characteristic semilunar or subtriangular appearance of those of *A. suborbicularis* and its congeners. The walls of the corallites are thin; and the margins of the calices, as noticed by M'Coy ('Brit. Foss.' p. 82), are sometimes tuberculated or coarsely granulated.

After a careful examination of well-preserved specimens, both on fractured surfaces and in polished sections, we have entirely failed to detect any mural pores. For reasons previously stated, we do not regard the apparent absence of pores in our specimens as absolutely conclusive as to their non-existence, though we are inclined to believe that the walls of the corallites are really imperforate.

The corallites of our examples of *A. septosa* are crossed by well-developed complete horizontal tabulæ, generally dispersed with great regularity; but the most remarkable feature is the presence in many of the corallites of a longitudinal or vertical ridge, partially dividing the visceral chamber into two portions. Sometimes this ridge is barely perceptible, or even wholly absent; at other times it extends halfway across the visceral cavity; and sometimes it nearly touches the opposite wall. In some parts of a large corallum almost every corallite may possess one of these ridges, whilst in other parts not a single structure of the kind is to be detected. Nor is there always but one of these ridges within the cavity of a single corallite, but there may be two or three, in which case one is generally much larger than the others. The significance and nature of these vertical ridges will be considered immediately; but it is in the meanwhile necessary to briefly glance at two corals which are very closely allied to *A. septosa*, and which undoubtedly belong to the same group.

One of the corals in question has been found by us in considerable abundance in the Carboniferous Limestone of the north of England. It occurs in the form of hemispherical, subglobose, or irregular masses, with a convex surface, often of considerable size, composed of prismatic corallites, which may or may not be arranged in successive superimposed layers half an inch or more in thickness. In other instances, the corallites are tall and basaltiform; but in either case they are " erect," in the sense in which this term has been previously used. The calices, therefore, are not *oblique*, but are like those of *A. septosa*. There are generally about five calices in one line; and though irregular in shape and size, they are essentially subhexagonal in shape. The walls of the corallites are thick; but we have wholly failed to discover any mural pores. In transverse sections, certain of the corallites show a strong tooth-like process on one side, sometimes opposed to two smaller teeth; and these ridges may be short, or they may extend halfway or more across the visceral chamber, whilst they are wanting altogether in a large number of the corallites. In longitudinal sections the corallites are seen to be crossed by remote horizontal tabulæ, which are not uncommonly placed at the same level in contiguous tubes, and which may be wanting altogether in certain layers.

The corals we have just described present a very close resemblance to *A. septosa*, Flem., from which they can only be distinguished by the smaller size of the corallites, the somewhat thicker walls of the tubes, and the slightly more remote tabulæ. Whether they may not be simply a variety of *A. septosa* we are not prepared to say; but we think little doubt can be entertained as to their substantial identity with the *Chætetes radians* of Fischer, a coral originally described from Russian specimens ('Oryct. de Moscou,' p. 160, pl. 33. fig. 3), but which is also quoted by Milne-Edwards and Haime from the Carboniferous Limestone of Kendal—on precisely the same horizon as some of our own specimens. We have unfortunately been unable to examine any authentic Russian examples of *Chætetes radians*; but our specimens agree so perfectly and in such minute particulars with those described and figured by Lonsdale ('Russ. and Ural,' Appendix, vol. i. p. 595, pl. A. fig. 9), that we are unable to hesitate as to their identity.

Lastly, in *Alveolites depressa*, Flem., we have a third coral which is obviously referable to the same group as the preceding two forms. The specimens which we possess of this species are large massive examples, agreeing in all essential points with the description given by Milne-Edwards and Haime, except that we cannot say that we have satisfactorily determined the presence of vertical ridges in the interior of any of the corallites. These, however, are both described and figured by the authors just mentioned. The species differs almost solely in the minute size of its tubes from the two preceding, the corallites being from eight to ten in the space of a line. The corallites are erect; the calices are subhexagonal and not oblique; the tabulæ are complete, remote, singularly regular, and often placed on the same level; no mural pores can be detected; and a rough fracture (as in the case of the two previously mentioned forms) exposes the interior of the corallites.

We have, then, arrived at the conviction that *Alveolites septosa*, Flem., *Chætetes radians*, Fischer, and *Alveolites depressa*, Flem., form a very natural group of corals, which chiefly differ from one another in the very trivial character that the corallites are of different dimensions. It still remains, however, for consideration to what generic group these forms can be properly referred; and on this question we have the following observations to make, the only points requiring special discussion being the presence or absence of mural pores, the nature of the so-called "septal tooth," and the relations of the corallites to one another.

As regards the first of these points, our specimens have only yielded the negative result that we have been unable to detect any signs of mural pores. In this particular instance, however, we are perhaps warranted in attaching great weight to this negative evidence, seeing that we have examined a large series of specimens from different localities, and from different beds, in different states of preservation, and by means of polished sections and thin transparent slices as well as by broken surfaces. We are disposed, then, to believe that mural pores are really wanting in *A. septosa*, Flem., *A. dèpressa*, Flem., and *Chætetes radians*, Fischer; and we may add that Milne-Edwards and Haime expressly affirm the absence of pores in the latter. If this view be correct, it is clear that the two first-mentioned of these forms can no longer be retained in *Alveolites*, from which they further differ in their comparatively erect corallites and their *non-oblique* calices.

As regards the second point, namely the nature of the so-called "septal tooth," this process is very conspicuous in *A. septosa* and in *Chætetes radians*, and can be most readily examined by means of thin sections cut at right angles to the course of the tubes. In *A. depressa* the same processes exist, though not so conspicuous; and we entertain no doubt as to their being of precisely the same nature in all these forms. By Milne-Edwards and Haime this tooth in *A. septosa* and *A. depressa* was regarded as representing a single primary septum; and they compared it with the elongated septal ridge of *A. suborbicularis*—an analogy which is increased by the fact that the process has sometimes one or two smaller teeth opposed to it, as in *A. denticulata*, E. & H. Against this view, however, it must be urged that the tooth-like process of *A. septosa* and *A. depressa* is by no means universal in its occurrence, nor constant in its development. It is only present occasionally, in certain of the calices, and is often absent over considerable areas, whilst it varies in size from a hardly perceptible protuberance up to a vertical lamina extending halfway or more across the visceral chamber. These facts militate strongly against the comparison of these processes to the septal ridges of *A. suborbicularis*; whilst several of our specimens of *A. septosa* show in addition numerous obscure longitudinal striæ, which we believe to be the true representatives of the septa. On the other hand, Lonsdale regarded the tooth-like processes of *Chætetes radians*, Fischer, as being of the nature of inflections of the walls of the corallite preliminary to its fission into two tubes. This view is supported by the easily observed fact that the mode of increase in *C. radians*, as well as in *A. septosa* and *A. depressa*, is clearly by fissiparity; and it is further supported by the very variable length of the process in different tubes, by its often extending half way, or almost quite, across the visceral chamber, and by its absence in all but a comparatively small number of corallites, and those the largest ones. Upon the whole, therefore, we are inclined to believe that the tooth-like processes of *A. septosa*, *A. depressa*, and *Chætetes radians* are not of a septal nature at all, but that they owe their existence to fission taking place in the older corallites.

In the third place, all the three corals in question exhibit the peculiarity that the walls of the corallites are firmly amalgamated in contiguous tubes, so that a fracture does not expose the *walls* of the tubes, but lays open the cavities of the visceral chambers. Mr. Lonsdale probably attached too great a value to this character in regarding it as one of the leading peculiarities of *Chætetes* as a genus; but there can be no doubt that it is a feature of importance.

Upon reviewing all the above evidence, it seems to us to be clear that *A. depressa*, Flem., and *A. septosa* *, Flem., can no longer be retained in the genus *Alveolites* as typified by *A. suborbicularis* and its allies. On the other hand, if more extensive investigations confirm, as we believe they will, the absence of mural pores, these species must be placed in the genus *Chætetes*, side by side with *C. radians*, Fischer, and they will stand as *C. depressus*, Flem., and *C. septosus*, Flem.

Group E. CHÆTETES, *Fischer*.

The groups known as *Chætetes*, Fischer, *Monticulipora*, D'Orb., and *Stenopora*, Lonsd., differ from *Favosites* and *Alveolites* mainly in the imperforate condition of the walls of the corallites; and this undoubtedly constitutes a character of great structural importance. Owing, however, to the very small size of the tubes of many species of these groups, the absence of mural pores is often a matter more of inference than of actual observation. Without, however, entering at the present moment further into the structure and affinities of these groups, we wish to describe a species of *Chætetes* from the Carboniferous rocks of Scotland, which is in many respects allied to the forms we have just been considering:—

Chætetes hyperboreus, Nich. & Eth.

Corallum forming thin, flattened, or undulating expansions, from one to five lines in thickness, not composed of superposed layers, and often half a foot or more in diameter. The corallum is not incrusting, but is attached to foreign bodies at one point; and the rest of the lower surface is covered with a strong wrinkled epitheca. Corallites erect, from an eighth to a tenth of a line in diameter. Calices opening upon the upper surface of the corallum, irregular in shape and size, but upon the whole more or less hexagonal, with thin walls, and wholly devoid of any trace of a septal apparatus or of septal teeth. Mural pores apparently absent. Tabulæ numerous, complete.

---

* It should be noted that this species was long ago described by M'Coy under the name *Chætetes septosus* (Pal. Foss. p. 82).

Most of our specimens of this form present the appearance believed by Mr. Lonsdale to be characteristic of *Chætetes*—that a rough fracture lays open the cavities of the corallites without exposing their walls. In some cases, however, the fractured surface shows the walls of the tubes; and in these, as well as in longitudinal sections, we have failed to detect any traces of mural pores. We were at first sight disposed to regard the present species as a variety of *C.* (*Alveolites*) *depressus*, Flem., with which it agrees in the size of the tubes. It is, however, sufficiently distinguished by its constantly different *form* and mode of growth, as well as by the fact, conclusively shown by thin transverse sections, that there are no traces whatever of ridges or teeth-like processes within the corallites. On the surface, the calices show a certain irregularity in form and size, which is not characteristic of the typical forms of *Chætetes*, whilst they are often transversely elongated, as in *C. septosus* and *C. depressus*. Horizontal sections, however, taken a little below the surface, prove that the corallites are essentially hexagonal in form.

Formation and Locality.—Carboniferous Limestone series, Charleston, Fife (abundant); Bathgate; Ecclefechan (Calciferous Sandstone).

Group F. ALVEOLITES GOLDFUSSI, *Billings.*

There still remain a number of forms which have been referred to *Alveolites*, and the true affinities of which are still doubtful. Many of these forms we have had no opportunity of sufficiently examining; and we merely wish to draw attention now to one or two corals which offer some troublesome difficulties. If we take *A. suborbicularis*, Lam., as the type of the genus *Alveolites*, we have already seen that the only essential point by which it can be separated from *Favosites* is the presence of a vertical septal ridge—three of these ridges existing in other allied forms. We have, however, some corals (such as *Alveolites Goldfussi*, Bill., and *A.*

Rœmeri, Bill., from the Devonian) which agree entirely with *Alveolites*, as generally understood, both in form and in the possession of a few irregular mural pores, but which differ from *A. suborbicularis* and its allies in possessing no traces whatever of septal ridges. In most characters these forms agree entirely with *A. Fougti*, E. & H., which has already been removed by Lindström to the genus *Favosites*. This would perhaps be the best course to pursue, provisionally at any rate, with forms such as *A. Goldfussi*, Bill.; but this would necessitate a further enlargement of the characters assigned to *Favosites*, since the corals in question differ both from the typical *Favosites* and from the aberrant *F.* (*Alveolites*) *Fougti*, in possessing few and remote mural pores. Further investigation will therefore be required before a final conclusion on this point can be arrived at.

DESCRIPTION OF PLATES XIX. & XX.

Fig. 1. A vertical section of the polished surface of a portion of *Chætetes* (*Alveolites*) *septosus*, Flem., from the "Vaults" Limestone, Lower Carboniferous group, Dunbar. Drawn from a specimen in the collection of the Geological Survey of Scotland (Edinburgh). Of natural size.

2. A portion of a horizontal section of the same specimen. At *a* is shown a portion of the matrix in which it was imbedded. Also of nat. size.

3. A small portion of the surface of fig. 2, considerably enlarged, showing the transverse sections of the corallites.

4. Applies to an outline of a flask-shaped specimen of the preceding coral, *Chætetes* (*Alveolites*) *septosus*, Flem. This was obtained from the Lower Carboniferous or Calciferous Sandstone series, Blackwood Ridge, New Quarry, Ecclefechan, Dumfriesshire. From the collection of the Geological Survey of Scotland (Edinb.). Outline reduced less than ½ nat. size.

5. The appearance of th weathered surface of the preceding, of nat. size.

6. Part of the same area as fig. 5, but considerably enlarged.

7. A partially longitudinal and somewhat obliquely fractured section of *Chætetes ? radians*, Fischer. From the Carboniferous Limestone, Hardendale, Nab, Shap, Westmoreland. Of nat. size, from a specimen in the cabinet of Prof. Nicholson.

8. A small portion of the weathered surface of the preceding specimen.

9. A horizontal section of the preceding as viewed under the microscope, and magnified about 6 diameters.

10. A vertical section of the same, also enlarged 6 diameters.

11. A portion of the exposed and slightly weathered surface of a mass of *Chætetes hyperboreus*, Nicholson and Etheridge. From the Lower Carboniferous Limestone group, Charleston, Fife. Drawn of nat. size from a specimen in the cabinet of Prof. Nicholson.

12. Exhibits a vertical view of part of the edge of the above slab of *Chætetes hyperboreus*, showing the comparative tenuity of the expansion. About nat. size.
13. A transparent vertical section of *Chætetes hyperboreus*, magnified 7 diameters.
14. A horizontal section of the same coral, × 7 diam.
15. The surface, slightly weathered, of a piece of *Pachypora lamellicornis*, Lindström. From the Wenlock (Upper Silurian), Gotland. Drawn of nat. size from a specimen in the cabinet of Prof. Nicholson.
16. A section in the plane of the frond of part of the same specimen of *P. lamellicornis*, rubbed down and viewed by transmitted light, × 4 diam. Owing to the undulations of the specimen, the section cuts across the corallites obliquely.
17. A section at right angles to the plane of the frond of the same, magnified 4 diam.
18. A superficial view of the surface of a fragment of *Pachypora* (*Alveolites*) *Fischeri*, Billings. From the Hamilton group, Middle Devonian, Arkona, Ontario. Encrinital joints are adherent to the surface of the specimen. Of nat. size and sketched from a specimen in Prof. Nicholson's cabinet.
19. A microscopical vertical section of fig. 18, × 7 diam.
20. A segment of a transparent horizontal section of the same, also magnified 7 diameters.
21. *Pachypora* (*Alveolites*) *frondosa*, Nicholson. Vertical transparent section, × 6 diam. Specimen obtained from the Hamilton group, Middle Devonian, Arkona, Ontario, and now in Prof, Nicholson's cabinet.
22. A vertical section of the same specimen of *P. frondosa*, also × 6 diameters.

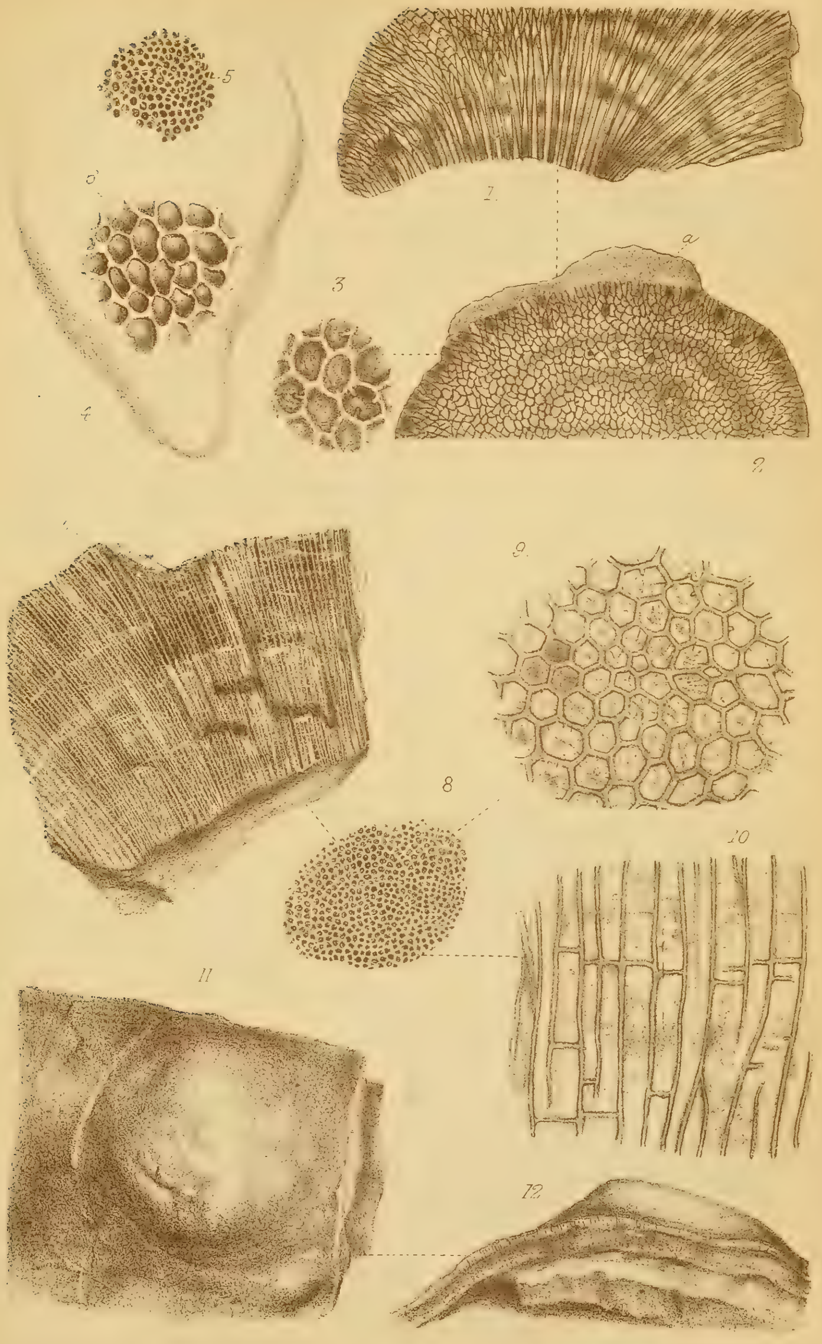
On the Sacral Plexus and Sacral Vertebræ of Lizards. By ST. GEORGE MIVART, Sec. L.S., and the Rev. ROBERT CLARKE, F.L.S.

[Read May 3, 1877.]

(Abstract.)

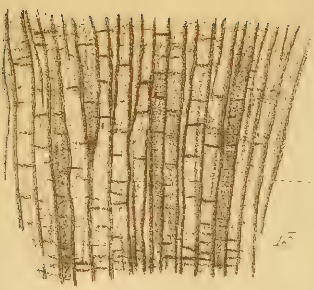
THE authors mention that of late it has been recognized that, in any attempt to answer the question as to which vertebra of any lower animal answers to the first sacral vertebra of Man, the nervous no less than the osteological relations of the parts should be carefully investigated. And it has been considered that the nervous rather than the osteological relations should be deemed the more important: in fact it has been sometimes asserted that the nerves must be taken as the fixed points, and that the bones must rather have their homology decided by the nerves, than *vice versâ*.

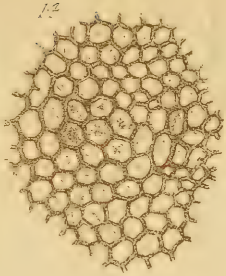
Should it be possible to show that in any group of reptiles, both

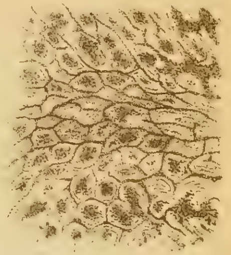


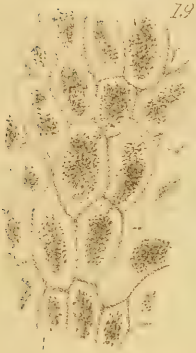
Berjeau. Lith.

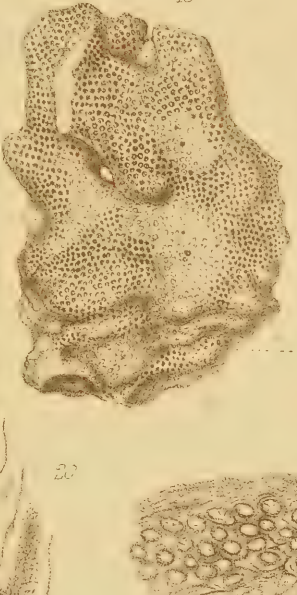
PALÆOZOIC CORALS

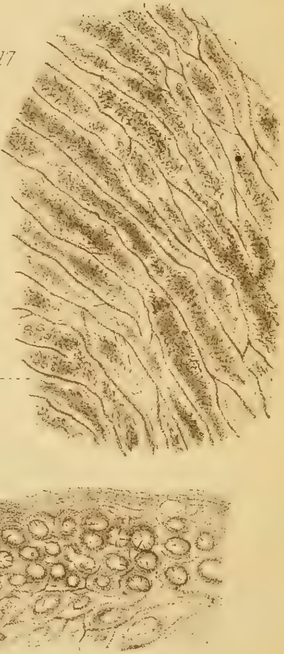

13

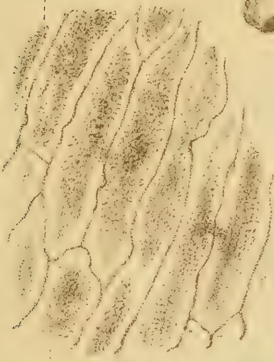

14

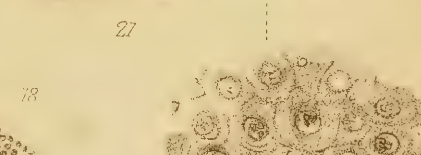

16

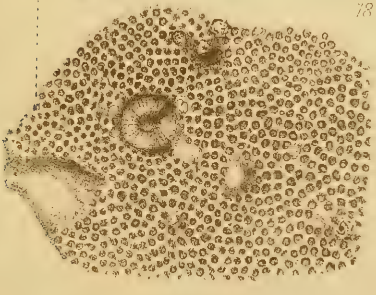

19

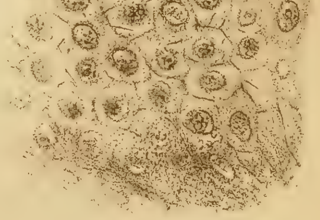

15


17


20


21


18


22

C. Berjeau, Lith.

Banks & Co. Edinr

PALÆOZOIC CORALS